APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/628,477	07/31/2000	Patrick H. Dussud	MS146913.1/40062.79-US-01	5539

7590 12/29/2003	EXAMINER
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ART UNIT	PAPER NUMBER
2172	

DATE MAILED: 12/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>21 October 2003</u>.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims | _ 2 o _ᴺ_ °⁹/₁₁/Ⱊₜ

4)☒ Claim(s) *1-4,11-14 and 20* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,11-14 and 20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR.1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

    a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.

4) ☐ Interview Summary (PTO-413) Paper No(s). _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

1.   Applicant's arguments filed on 10/21/2003 with respect to claims 1-20 have been

considered but are moot in view of the new ground(s) of rejection.

2.   Claims 1-20 are pending in this application.

3.   Claims 5-10 and 15-19 are allowed

Allowable Subject Matter

4.   The following is an examiner's statement of reasons for allowance:

Claims 5, 10 and 15 are allowable. Since the claims 5, 10 and 15 include multiple

threads or modules such as marking, planning and relocating.

Claim Rejections - 35 USC § 103

5.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

6.   Claims 1-4, 11-14 and 20 are rejected under 35 U.S.C. 103(a) as being

unpatentable over US Patent No. 6,289,360 issued to Kolodner et al. (herein Kolodner)

in view of "Evaluation of Parallel Copying Garbage Collection on a Shared-Memory

Multiprocessor" of Akira Imai and Evan Tick (hereinafter Imai-Tick).

        With respect to claim 1, Kolodner discloses performing a plurality of garbage

collection phases (mark and sweep phases: col. 2, lines 1-18),

        each processor performs each of the phases on the heap dedicated to the

processor using a garbage collection thread executing on the processor (collector

threads to force synchronization process: col. 3, lines 25-45 and col. 5, lines 4-14);

        and synchronizing the processors so that all processors have completed the

preceding phase prior to each processor beginning the next phase (the beginning phase

and the ending phase of the mark-sweep cycle and the synchronization process is

between the mark-sweep phases: abstract, col. 2, lines 57-67; also col. 3, lines 25-45

and col. 5, lines 44-61).

        Kolodner discloses garbage collection phases, mark and sweep phases,

synchronization between object allocation between the phrases, the processor is couple

to memory and a heap implemented in shared memory having mark, sweep phases,

and synchronization operation performs be a thread in a multiprocessor system.

Kolodner does not explicitly teach locally dividing the memory into a plurality of heaps,

each heap dedicated to one process for garbage collection.

However, Imai-Tick discloses the parallelism in garbage collection, where the multiple processors are accepted and multiple heaps corresponding to the multiple processors (page 1031 in the section of How to Exploit Parallelism).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine the teachings of Kolodner with the teachings of Imai-Tick so as to obtain parallelism in garbage collection in order to include a plurality of heaps, and each heap is associated for each processor for garbage collection. This combination would made the method for memory accesses being performed without mutual exclusion and this would avoid the cost locking and be effective in spreading the work among a limited number of multiple processor and eliminating synchronization between sweep and allocating of a newly created object in a concurrent garbage collector for a heap implemented in shared memory having mark and sweet phases (Kolodner – col. 6, lines 55-67) in the memory management environment.

With respect to claim 2, Kolodner discloses for each processor performing a phase of the garbage collection process, upon completion of the phase of the garbage collection process waiting for the other processors to complete the phase of the garbage collection process (col. 10, lines 8-18 and lines 48-55); and once the other processors have completed the phase of the garbage collection process, beginning the next phase of the garbage collection process (col. 5, lines 44-61; also col. 2, lines 32-42).

With respect to claim 3, Kolodner discloses a marking phase that marks all reachable objects in memory; a planning phase that plans the relocation of the objects; a relocation phase that updates the object references based on information calculated by the planning phase; and a compaction phase that compacts the reachable objects in memory (collection mark-sweep cycle: see fig. 7; also fig. 6, col. 10, lines 8-47, see abstract and fig. 10, col. 11, lines 25-31).

With respect to claim 4, Kolodner discloses analyzing each memory object to retrieve references to other memory object; if a reference to another memory object is present, analyzing the reference information to determine which heap the referenced object is associated; analyzing the directory of the heap for the referenced object to determine a new address location of the referenced object; and updating the reference information in the memory object (col. 10, lines 8-47, col. 11, lines 65-67 and col. 12, lines 1-12).

Claim 11 is essentially the same as claim 1 except that it is directed to a computer program product readable by a computer rather than a method, and is rejected for the same reason as applied to the claim 1 hereinabove.

Claim 12 is essentially the same as claim 2 except that it is directed to a computer program product readable by a computer rather than a method (col. 5, lines 44-61; also col. 2, lines 32-42), and is rejected for the same reason as applied to the claim 2 hereinabove.

Claim 13 is essentially the same as claim 3 except that it is directed to a computer program product readable by a computer rather than a method (collection

mark-sweep cycle: see fig. 7; also fig. 6, col. 10, lines 8-47, see abstract and fig. 10, col.

11, lines 25-31), and is rejected for the same reason as applied to the claim 3

hereinabove.

Claim 14 is essentially the same as claim 4 except that it is directed to a

computer program product readable by a computer rather than a method (col. 10, lines

8-47, col. 11, lines 65-67 and col. 12, lines 1-12), and is rejected for the same reason as

applied to the claim 4 hereinabove.

With respect to claim 20, Kolodner discloses a plurality of garbage collection

modules for reclaiming unused memory objects located within the shared memory, each

garbage collection module associated with a processing unit, each garbage collection

module operates on a dedicated heap of memory (see fig. 2 and col. 2, lines 50-67 and

col. 3, lines 1-3 and col. 5, lines 62-67).

a synchronizing module for synchronizing the activities performed by the garbage

collection modules (col. 3, lines 25-45; also col. 2, lines 18-32).

Kolodner discloses garbage collection phases, mark and sweep phases,

synchronization between object allocation between the phrases, the processor is couple

to memory and a heap implemented in shared memory having mark, sweep phases,

and synchronization operation performs be a thread in a multiprocessor system.

Kolodner does not explicitly teach a dedicated heap of memory..

However, Imai-Tick discloses the parallelism in garbage collection, where the

multiple processors are accepted and multiple heaps corresponding to the multiple

processors (page 1031 in the section of How to Exploit Parallelism).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine the teachings of Kolodner with the teachings of Imai-Tick so as to obtain parallelism in garbage collection in order to include a plurality of heaps, and each heap is associated for each processor for garbage collection. This combination would made the method for memory accesses being performed without mutual exclusion and this would avoid the cost locking and be effective in spreading the work among a limited number of multiple processor and eliminating synchronization between sweep and allocating of a newly created object in a concurrent garbage collector for a heap implemented in shared memory having mark and sweet phases (Kolodner – col. 6, lines 55-67) in the memory management environment.

Contact Information

7.   Any inquiry concerning this communication should be directed to Anh Ly whose

telephone number is (703) 306-4527 or via E-Mail: **ANH.LY@USPTO.GOV**. The

examiner can be reached on Monday – Friday from 8:00 AM to 4:00 PM.

If attempts to reach the examiner are unsuccessful, see the examiner's

supervisor, John Breene, can be reached on (703) 305-9790.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to: (703) 872-9306 (Central Official Fax Number)

Hand-delivered responses should be brought to Crystal Park II, 2121 Crystal

Drive, Arlington, VA, Fourth Floor (receptionist).

Inquiries of a general nature or relating to the status of this application should be

directed to the Group receptionist whose telephone number is (703) 305-3900.

AL
DEC. 19th, 2003

12/19/03